

NETWORK SWITCH DISCOVERY METHOD AND APPARATUS

Background of the Invention

5 This invention relates to networks, and more specifically, to apparatus and methods for determining the closest switch to a network device.

10 In management of networks, it is desirable to determine how a given network is physically wired. However, such information is not readily apparent or discoverable, as the network is normally spread over a considerable distance, with components thereof located in multiple physical locations. The actual wiring configuration between any given physical locations is essentially interminable by inspection, as network
15 cables (or wireless links) will traverse many structural components of buildings and the like. It becomes desirable to have a way to determine what switches are directly connected to a host device in order to assist in the management of the network.

20 In switched networks, a problem in determining connectivity is that it is common for switches to not transmit much, so that it is likely that some switches in a subnet will be unaware of other switches.

Summary of the Invention

25 In accordance with the invention, a method and apparatus for determining switch connectivity to a device on a network constructs a databases of all the forwarding tables of all the switches on a subnet of a network and is able to determine connectivity
30 therefrom.

Accordingly, it is an object of the present invention to provide an improved method of determining switch connectivity on a network.

35 It is a further object of the present invention to provide an improved apparatus for discovering how

Express Mail #EL 778108361 US

switches on a network are connected.

It is yet another object of the present invention to provide an improved method and apparatus for testing networks.

5 It is a further object of the present invention to provide an improved method and apparatus for determining switch connectivity on a subnet of an Ethernet local area network.

10 A still further object of the present invention is to provide an improved computer program for deciding how a selected switch on a local area network is connected to a host.

15 The subject matter of the present invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. However, both the organization and method of operation, together with further advantages and objects thereof, may best be understood by reference to the following description taken in connection with accompanying drawings wherein
20 like reference characters refer to like elements.

Brief Description of the Drawings

FIG. 1 is a block diagram of an example network employing the system according to the present
25 invention;

FIG. 2 is a flow chart of steps in performing the invention; and

FIG. 3 is a flow chart of a part of the steps in building the switch to switch connectivity.
30

Detailed Description

The system according to a preferred embodiment of the present invention comprises a method and apparatus for determining the closest switches to a network
35 device. Those switches that are directly connected

(i.e. no intervening switches are between the device and a directly connecting switch) are determined and identified.

Referring now to FIG. 1, a block diagram of an example network, which may comprise, for example, an Ethernet local area network, employing the system according to the present invention, the invention is suitably configured as a test instrument 10, which may comprise, in a preferred embodiment, a computer 12 which is connected to a network hub 16 via network interface 14. A HOST 17 is connected to the hub in the illustrated embodiment. The HOST may comprise a device on the network, for example, and it is possible that the test instrument 10 could be the host, but in the illustrated configuration, the HOST 17 and the test instrument 10 are separate devices connected to separate ports on the hub. In the illustrated example, the network to which the HOST is interfaced comprises hub 16 and three switches, SWITCH A (18), SWITCH B (20) and SWITCH C (22). Suitably, the network may comprise an Ethernet local area network (LAN). In the illustrated network configuration, SWITCH A is connected via its port 1 (P1) to a port P2 of SWITCH B, while port P3 (SWITCH B) connects to the hub 16. SWITCH C is also connected to the hub through port 4 (P4). Of course, each switch may have a plurality of other devices connected thereto, as may the hub.

As noted hereinabove, it may be desirable to determine which of the switches are directly connected to the HOST, which in the illustrated embodiment is operating as a network test instrument. Such information is not easily determined by mere inspection of the equipment.

If switch B sees switch C, but switch C does not see switch B, then in accordance with the invention, a

search is performed to find a device in the forwarding table of switch B that is not on the port that switch C is on but that is seen by switch C. Then, the port on switch C that contains this particular device is known
5 to be the same port that switch B is connected to. If switch B does not see switch C, then according to the invention, two different devices are located on two separate ports on switch B that are seen on the same port of switch C. That port on switch C is then known
10 to be the port that is connected to switch B.

Thus, suitably all forwarding information on a subnet is gathered into a common database. This database is then examined to determine the switch to switch awareness on the subnet. If any awareness is
15 missing, then according to the steps discussed above, those awareness "blanks" are resolved.

Referring now to FIG. 2, which is a flow chart of steps in performing the invention, when it is desired to determine switches that are directly connected to
20 the HOST, in accordance with the invention, a database is generated (step 24) of the switch/port/host combinations on the network (which, may comprise a sub network). To accomplish this, the forwarding tables for the switches in the network are queried by the test
25 instrument 10 to obtain the data for generating the table. This data tells which port a given switch will use to access a particular host. As discussed above, a database is constructed of the forwarding information, and the connectivity of the switches is resolved.

30 FIG. 3 shows steps involved in filling in missing switch connectivity in the database construction, which results from building a common database of all the forwarding information from switches on a subnet. The database information discussed herein suitably includes
35 MAC (media access control) addresses. This database

includes all the forwarding information from the switches on a subnet, and may, for a particular switch, include gaps from a switch not knowing the connectivity to another switch. Thus, the connectivity gaps are resolved and filled in to complete the database. First, in step 40, a first and second switch are selected, denoted switch A and switch B in this example. Then, at decision step 42 if switch A can "see" switch B (that is, does switch A know how it connects to switch B) but if switch B cannot see switch A, then in step 44, the database is searched to find another device in the forwarding table of switch A which is known by switch B but is not on the port that switch B is on to connect to switch A. This is then the port on which B connects to A.

If switch A does not see switch B (decision 46), then the database is searched for two other devices that are on separate ports of switch A but that are seen on the same port of switch B. Then it is known that the port on switch B is the port that is connected to switch A.

These steps are repeated for the combination of switches, to generate the switch to switch connectivity table.

Next, returning to FIG. 2, in step 26, the table that was generated is searched to locate all the switches that include a listing for the HOST. These switches are placed in a table and a first switch is selected, called the selected switch, (step 28) to begin processing of all the switches in the table.

In decision block 30, a determination is made as to whether all the other switches in the table generated in step 26 list the selected switch as being on the same port as the HOST. The data for each of the other switches (except the selected switch) in the

table is suitably examined until either: 1) a switch
table entry is found where the port indicated by that
particular switch table entry for access to the HOST
differs from the table entry for access to the selected
5 switch, or 2) all the switches in the table have been
examined. If a switch is found that has different
ports listed for the HOST and selected switch, then we
know that the selected switch is not directly connected
to the HOST. In such case, the answer to decision
10 block 30 is "no" and step 32 indicates that the
selected switch is not connected directly to our HOST.
Processing then continues with decision block 36
discussed hereinbelow.

If no switch was found that lists different ports
15 for the HOST and the selected switch, then block 34 is
entered, indicating that the selected switch is
directly connected to the HOST. Now, decision block 36
is entered (or, as noted hereinabove, decision block 36
may also be entered via block 32) and a determination
20 is made whether all switches (in the table of switches
that list the HOST) have been processed. If so, then
the process is done. If not, then block 38 is
performed to select a next switch in the table of
switches that list the HOST, and processing continues,
25 looping back to decision block 30. The loop continues
until all the switches in the table of switches listing
the HOST have been processed.

The information for each switch from blocks 32 and
34 is suitably collected and used for further
30 procedures relating to network maintenance.

Referring again to FIG. 1, employing the invention
with the illustrated network configuration results in
the information that SWITCH A sees the HOST 17 on port
1, SWITCH B sees the HOST on port 3 and SWITCH C sees
35 the HOST on port 4. It is determined that SWITCH A is

not directly connected to the HOST because SWITCH B
sees SWITCH A on port 2 but sees the HOST on port 3.
SWITCH B is directly connected to the HOST because
SWITCH A sees both the HOST and SWITCH B on port 1 and
5 SWITCH C sees both the HOST and SWITCH B on port 4.
SWITCH C is determined to be directly connected because
SWITCH A sees SWITCH C and the HOST both on port 1 and
SWITCH B sees both SWITCH C and the HOST on port 3.

While the illustrated example shows a relatively
10 small network, in practice, a network may have hundreds
of nodes and the determination may be made for plural,
different hosts, to generate a representation of the
network configuration. The configuration of FIG. 1 is
simply an example of a possible network configuration,
15 and it will be understood that the HOST 17 is not
required to be connected to the same hub or switch as
the test instrument.

In the preferred embodiment, the invention is
implemented as a software program, suitably operating
20 on a computer connected to a network. However, an
alternate embodiment comprises a network test
instrument incorporating the invention therein.
Accordingly, an apparatus and method of determining
switches that are directly connected to a host on a
25 computer network is provided by the invention. The
switch connection determination is suitable for
information and analysis of the physical connection
profile of a network, which may be useful to network
management professionals in maintaining and optimizing
30 operation of the network.

While a preferred embodiment of the present
invention has been shown and described, it will be
apparent to those skilled in the art that many changes
and modifications may be made without departing from
35 the invention in its broader aspects. The appended

5
10
15
20
25
30
35